



U.S. DEPARTMENT OF
ENERGY

Nuclear Energy

Nuclear Energy University Programs (NEUP) Fiscal Year (FY) 2013 Annual Planning Webinar

Used Fuel Disposition

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Used Fuel Disposition Overview

■ DOE Office of Nuclear Energy Mission

- The primary mission of the Office of Nuclear Energy is to advance nuclear power as a resource capable of meeting the Nation's energy, environmental, and national security needs by resolving technical, cost, safety, proliferation resistance, and security barriers through research, development, and demonstration as appropriate.

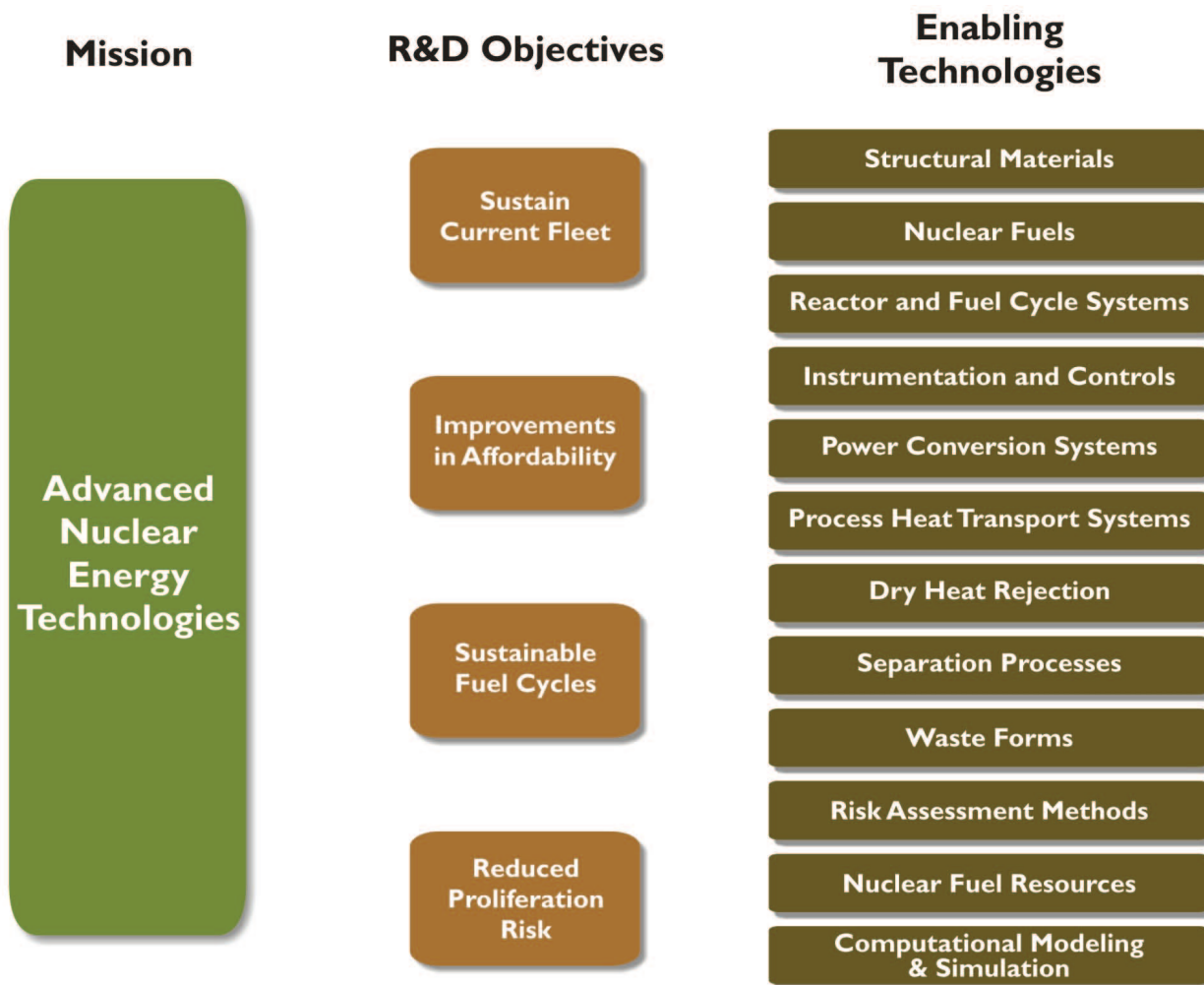
■ Used Fuel Disposition Mission

- The mission of the Used Fuel Disposition Campaign is to identify alternatives and conduct scientific research and technology development to enable storage, transportation and disposal of used nuclear fuel and wastes generated by existing and future nuclear fuel cycles.



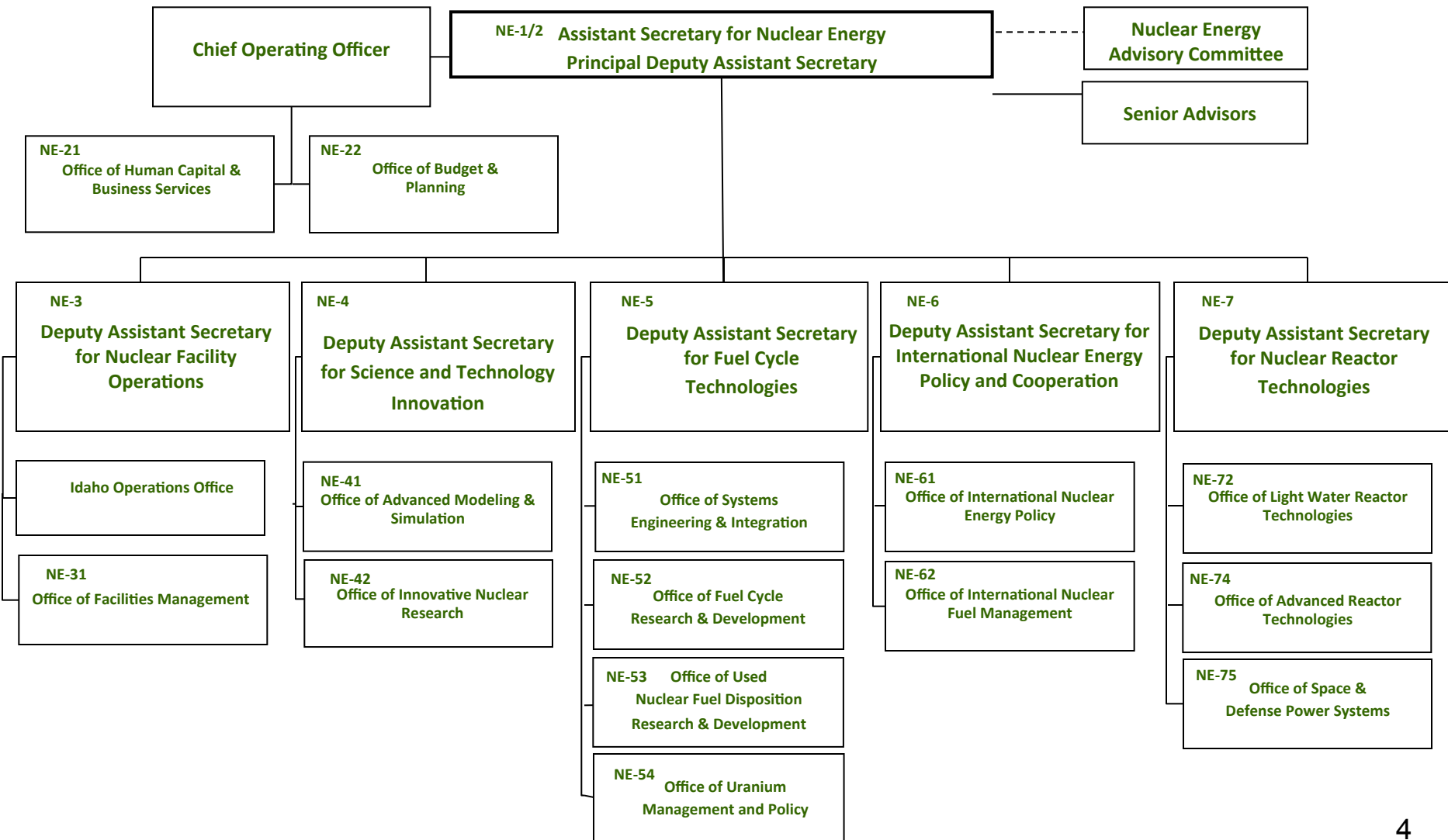
DOE-NE Mission and Objectives

(from the 2010 DOE-NE Roadmap Report to Congress)





Proposed Organization





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Used Fuel Disposition Campaign R&D Participants





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- **The *Grand Challenge* for the Used Fuel Disposition Campaign is to provide a sound technical basis for absolute confidence in the safety and security of long-term storage, transportation, and disposal of used nuclear fuel and wastes from the nuclear energy enterprise.**
 - **Importance: Supports the establishment of UNF management and disposition pathways**



Used Fuel Disposition Research Needs

■ **Storage/Transportation**

- Develop the technical bases to demonstrate used fuel integrity for extended storage periods
- Develop the technical bases to for fuel retrievability and transportation after extended storage
- Develop the technical bases to for transportation of high burnup fuel

■ **Disposal**

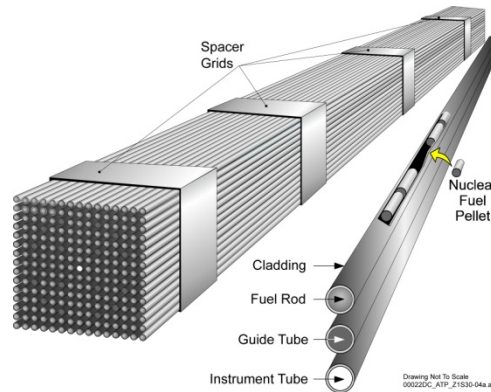
- Provide a sound technical basis for the assertion that the US has multiple viable disposal options that will be available when national policy is ready
- Identify and research generic sources of uncertainty that challenge the viability of disposal concepts
- Increase confidence in robustness of generic disposal concepts to reduce the impact of unavoidable site-specific complexity
- Develop the science and engineering tools required to address the needs above



Storage System Components

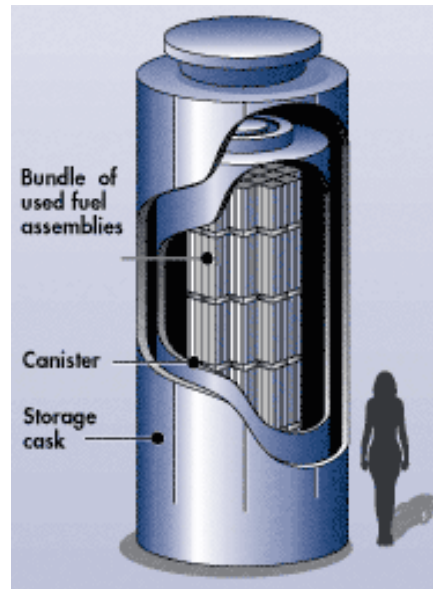
I. Fuel

- I. Fuel/Pellet
- II. Cladding
- III. Assembly hardware



II. Cask

- I. Internals (baskets, neutron poisons)
- II. Container (canister, welds, seals, bolts)
- III. Overpack/Storage module



III. ISFSI

- I. Pad
- II. Rebar
- III. Physical Protection



IV. Monitoring Systems

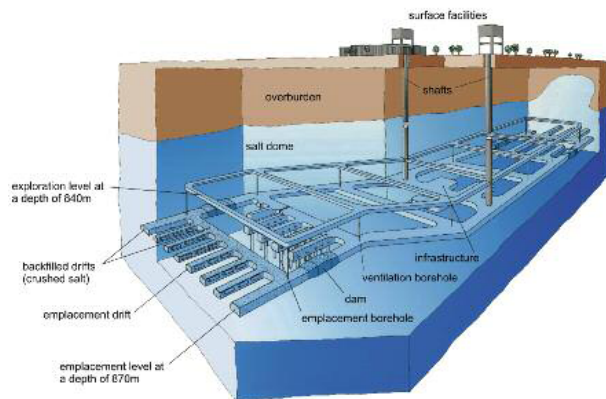
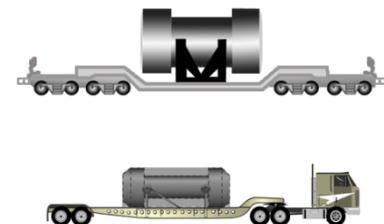
- I. Remote inspection
- II. In-package sensors
- III. Security



NEUP FY 2013 R&D Work Scope

Description: Used Fuel Disposition FC-4

- **Goals: Develop technologies for storing, transporting, and disposing of used nuclear fuel and assessing performance of waste forms in the associated storage and disposal environments**



- **Focus of the research**
 - Storage (FC- 4.1)
 - Transportation (FC- 4.2)
 - Disposal (FC- 4.3)



Used Fuel Storage (FC-4.1) Focus Areas for University Proposals

Key university research needs for used fuel storage includes:

- Innovative approaches to evaluating degradation and aging phenomena of used nuclear fuel, containers and internals, and storage facilities under extended storage
- Data and risk informed assessment methods for high-burnup used nuclear fuel for extended storage applications
- Development of a superior concrete by chemical additives and curing improvements that would increase the compressive strength, tensile strength and weather ability of the concrete. This work would not include the addition of mechanical additives such as fiber glass or metal wire. This concrete could then be used for extended used nuclear fuel storage
- Development of non-destructive techniques to monitor long-term effects of wet/dry, freeze/thaw, marine environment effects, the temperature fluctuations and radiation effects on reinforcing steel and concrete used in the over pack of dry storage system
- Innovative research in developing poison materials for long-term criticality control



Used Fuel Transportation (FC-4.2) Focus Areas for University Proposals

Key university research needs for used fuel transportation includes:

- **Materials research that would facilitate transportation of used nuclear fuel**
- **Structural integrity assessment for transporting used nuclear fuel with uncertainty in input consideration**
- **Advanced modeling approaches for radiological analyses of disruptive scenarios relevant to transportation**
- **Data relevant to risk-informed cask qualification and transportation behavior of high-burnup and advanced fuels**



Used Fuel Disposal (FC-4.3) Focus Areas for University Proposals

Key university research needs for used fuel transportation includes:

- Improved understanding of degradation processes (i.e., corrosion and leaching) for used nuclear fuel and waste forms that could be generated in advanced nuclear fuel cycles (i.e., glass, ceramic, metallic) through experimental investigations under variable conditions of saturation, temperature, and water chemistry, leading to the development of improved models to represent these processes
- Improved understanding of the degradation processes for engineered barrier materials (i.e., waste containers/packages, buffers, seals) and radionuclide transport processes through these materials leading to the development of improved models to represent these processes
- Improved understanding of coupled thermal-mechanical-hydrologic-chemical processes in the near-field of relevant disposal model environments, leading to the development of improved models to represent these processes
- Improved understanding of large-scale hydrologic and radionuclide transport processes in the geosphere of relevant disposal model environments, leading to the development of improved models to represent these processes



Used Fuel Disposal (FC-4.3) Focus Areas for University Proposals (Contd.)

Key university research needs for used fuel transportation includes:

- Development of new techniques for in-situ field characterization of hydrologic, mechanical, and chemical properties of host media and groundwater in a borehole or an excavated tunnel;
- Aqueous speciation and surface sorption at elevated temperatures and geochemical conditions (e.g., high ionic strength) relevant to the disposal environments being considered;
- Consideration of how specific waste forms may perform in different disposal environments using theoretical approaches, models, and/or experiments, with quantitative evaluations including uncertainties of how the long-term performance of waste forms can be matched to different geologic media and disposal concepts.
- Experimental and modeling investigations for the effect of radiolysis on used fuel, high-level waste, and barrier material degradation at temperatures and geochemical conditions relevant to potential storage and disposal environments.